Division 10
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NATIONAL BUREAU OF STANDARDS REPORT

6625

PERFORMANCE TESTS OF A FARR "MICROLOC"
REPLACEABLE MEDIA AIR FILTER

Manufactured by
Farr Company
Los Angeles, California

by

Carl W. Coblentz
and
Paul R. Achenbach

Report to

Public Buildings Service
General Services Administration
Washington 25, D. C.

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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Carl W. Coblentz and Paul R. Achenbach
Air Conditioning, Heating, and Refrigeration Section
Building Technology Division

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Performance Test of a Farr "Microloc" Replaceable Media Air Filter

by

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1. INTRODUCTION

At the request of the Public Buildings Service, General Services Administration, the performance characteristics of a Farr "Microloc" air filter were determined. The scope of this examination included the determination of the pressure drop and the dust holding capacity of the filter, and separate determinations of the arrestance of Cottrell precipitate and the particulate matter in the laboratory air.

2. DESCRIPTION OF TEST SPECIMEN

The filter was manufactured and supplied for test purposes by the Farr Company of Los Angeles, California. It was identified as their model "Microloc with filter media #2." The steel frame had face dimensions of 20" x 20" corresponding to a face area of 2.78 sq ft and was 32" deep. The filter media consisted of five strips, each 60 1/2" x 18 1/2" of felted material, approximately 5/8" thick. Each length was folded over a wedge shaped spring steel wire frame that fitted into the housing and when the springs were released, formed one 30-in. deep pleat. The filter medium was supported and sealed against air leaks at the edges by perforated steel sheet. The total effective filter area was approximately 38 sq ft, i.e. the mean air velocity through the filter media at 1000 cfm air flow rate was about 26 ft/min.

The housing was designed to hold a 20" x 20" x 2" viscid impingement pre-filter. This test was performed without a pre-filter, at the request of the General Services Administration.

3. TEST METHOD AND PROCEDURE

Arrestance determinations were made by the NBS "Dust Spot Method" using the following aerosols: a) the particulate matter in the laboratory air, and, b) Cottrell precipitate. The test method is described in the paper "A Test Method for Air Filters," by R. S. Dill (ASHVE Transactions, Vol. 44, p. 379, 1938).

The sampling air was drawn from the center points of the test duct one foot upstream and eight feet downstream of the air filter assembly at equal flow rates and passed through known areas of Whatman No. 41 filter paper. The change of opacity of these areas was determined with a sensitive photometer which measured the light transmission of the same area on each sampling paper before and after the test. The two sampling papers used for each test were selected to have the same light transmission readings when clean.

For determining the arrestance of the filter with Cottrell precipitate as the aerosol, different sized areas of sampling paper were used upstream and downstream of the filter to collect the dust, in order to obtain a similar increase of opacity on both samplers. The arrestance, A (in percent) was then calculated by the formula:

$$A = \left(1 - \frac{S_D}{S_U} \times \frac{\Delta D}{\Delta U} \right) \times 100$$

where S_D and S_U are the downstream and upstram areas and ΔD and ΔU the observed changes in opacity of the downstream and upstram sampling papers, respectively.

A slightly different sampling procedure was used for determining the arrestance of the particulate matter in the laboratory air. In this case, a similar increase of opacity on the two sampling papers was obtained by using similar or equal areas of the upstram and downstream sampling papers and passing air through the upstream sampler only part of the time while operating the downstream sampler continuously. This was accomplished by operating the upstream sampler with an electric timer which controlled two solenoid valves, one in series with the sampler and the other bypassing the sampler. The timer could be set to open the solenoid valve in series with the upstream sampler any desired percentage of a 5-minute cycle while bypassing the sampler during the rest of the cycle. The arrestance, A (in percent) was then determined with the following formula:

$$A = 100 - T \times \frac{S_D}{S_U} \times \frac{\Delta D}{\Delta U}$$

where T is the percentage of time during which air was drawn through the upstream sampler, the other values being the same as previously indicated.

The following procedure was employed in the testing of this filter. The test specimen was assembled in accordance with the manufacturer's instructions and installed into the test apparatus. Measurements were made of the pressure drop across the filter in the range from +20% to -20% of the rated air flow rate of 1000 cfm. Several arrestance determinations were then made at 1000 cfm air flow with the particulate matter in the laboratory air as the aerosol. Thereafter, an arrestance determination was made with Cottrell precipitate and then the loading of the filter with Cottrell precipitate and lint in a ratio of 96 to 4, by weight, was commenced with a feed rate of approximately 1 gram of Cottrell precipitate per 1000 cu ft of air.

The Cottrell precipitate used had been sifted through a 100-mesh standard wire screen and the lint was #7 cotton linters run through a Wiley mill with a 4 mm screen.

Further arrestance determinations with Cottrell precipitate were made after about each 100 g additional dust were introduced into the test apparatus. The test was terminated when the pressure drop had reached about 1.0 in. W.G. Additional determinations of the arrestance of the particulate matter in the laboratory air were made when the filter was about halfway loaded and at the conclusion of the test.

4. TEST RESULTS

The performance data obtained at 1000 cfm air flow rate are summarized in Table 1, presenting the pressure drop and arrestance values for the air-borne dust in the laboratory air and Cottrell precipitate at different dust load conditions. The dust load shown in this table is the weight of Cottrell precipitate introduced into the test apparatus diminished by the percentage of dust fallout upstream of the filter. This fallout was determined after the conclusion of the test by sweeping out the test apparatus. The amount of dust swept out of the upstream portion of the test duct was 30 g or 4.4 percent of the total of 684 grams of Cottrell precipitate and lint introduced into the system during the test.

Table 1

Performance of Farr "Microloc" Air Filter

Dust Load g	Pressure Drop in. W.G.	Arrestance %	Aerosol Used**
0	0.478	71.7*	A
10	0.480	97.0	B
128	0.514	97.3	B
306	0.581	95.8*	B
475	0.701	85.7	A
614	0.858	97.6*	B
654	0.975	83.3*	A

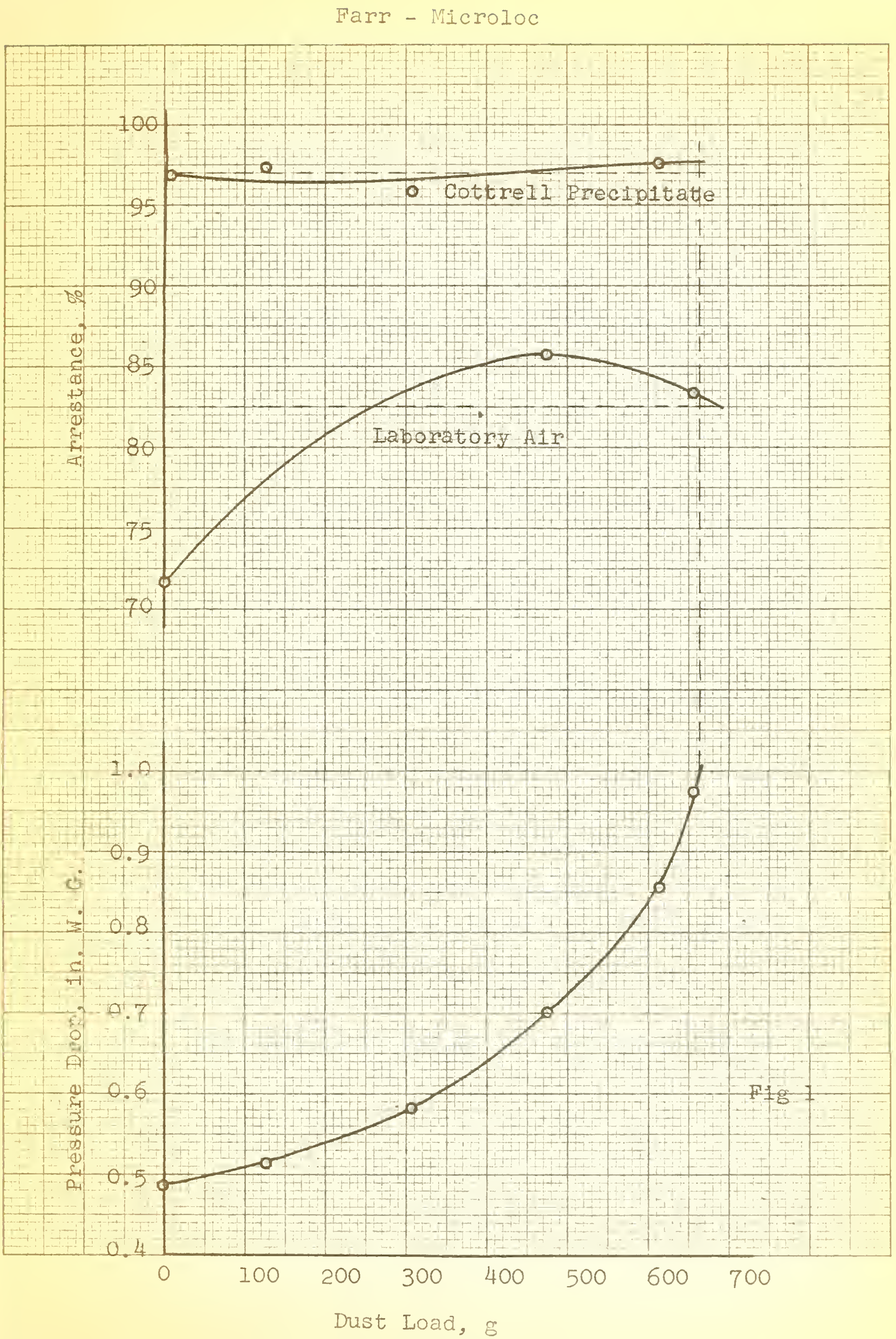
* Average of two or more tests

** A - Particulate matter in laboratory air
B - Cottrell precipitate in laboratory air (Rate of feed = 1 gram per 1000 cu ft)

It will be noted that the pressure drop of the clean filter was 0.478 in. W.G. and increased to 0.975 in. W.G. after 654 grams of dust had reached the specimen. The arrestance of Cottrell precipitate remained practically constant at 97 percent throughout the test. The arrestance of the filter with the particulate matter of the laboratory air used as the aerosol increased from 71.7 percent when the filter was clean to 85.7 percent at a filter load of 475 grams and then decreased again to 83.3 percent at the end of the test.

The values of Table 1 are graphically presented in Figure 1 in which both the pressure drop and the arrestance values are plotted against the dust load as smooth curves that approximately fit the individual points of observation. The vertical dashed line indicates that the dust load at 1.0 in. W.G. pressure drop would be approximately 665 grams. The horizontal dashed lines indicate the mean arrestance during the period in which a dust load of 665 grams was accumulated. The mean arrestance determined for Cottrell precipitate was 97 percent and that for air-borne dust 82.5 percent.

Table 2 shows the pressure drop of the clean test specimen at air flow rates from 20% above to 20% below the rated 1000 cfm flow. At 800 cfm air flow rate, the pressure drop decreased to 0.364 in. W.G, 24 percent below the 0.478 in. W.G. at 1000 cfm



Farr - Microloc
Cottrell Precipitate
Laboratory Air
Arrestance, %
100
95
90
85
80
75
70
Pressure Drop, in. W. G.
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0
100
200
300
400
500
600
700
Dust Load, g
Fig 1

air flow rate. It increased at an equal rate when the air flow rate was increased to 1200 cfm, the pressure drop was then 0.592 in. W.G.

Table 2

Pressure Drop of Farr "Microloc" Filter When Clean

Air Flow Rate cfm	Pressure Drop in. W.G.
800	0.364
1000	0.478
1200	0.592

The effect of the operation of this filter in combination with a panel type pre-filter cannot be predicted from this test. It appears unlikely that such an arrangement would have much beneficial effect on the arrestance, however, the dust holding capacity may be increased if the filter is operated with a pre-filter.

U.S. DEPARTMENT OF COMMERCE
Frederick H. Mueller, *Secretary*

NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

THE NATIONAL BUREAU OF STANDARDS

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WASHINGTON, D.C.

Electricity and Electronics. Resistance and Reactance. Electron Devices. Electrical Instruments. Magnetic Measurements. Dielectrics. Engineering Electronics. Electronic Instrumentation. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Photographic Technology. Length. Engineering Metrology.

Heat. Temperature Physics. Thermodynamics. Cryogenic Physics. Rheology. Molecular Kinetics. Free Radicals Research.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Physics. Radiation Theory. Radioactivity. X-rays. High Energy Radiation. Nucleonic Instrumentation. Radiological Equipment.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Molecular Structure and Properties of Gases. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Fluid Mechanics. Engineering Mechanics. Mass and Scale. Capacity, Density, and Fluid Meters. Combustion Controls.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Constitution and Microstructure.

Building Technology. Structural Engineering. Fire Protection. Air Conditioning, Heating, and Refrigeration. Floor, Roof, and Wall Coverings. Codes and Safety Standards. Heat Transfer. Concreting Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics.

Data Processing Systems. SEAC Engineering Group. Components and Techniques. Digital Circuitry. Digital Systems. Analog Systems. Application Engineering.

• Office of Basic Instrumentation.

• Office of Weights and Measures.

BOULDER, COLORADO

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

Radio Propagation Physics. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Sun-Earth Relationships. VHF Research. Radio Warning Services. Airglow and Aurora. Radio Astronomy and Arctic Propagation.

Radio Propagation Engineering. Data Reduction Instrumentation. Modulation Research. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation Obstacles Engineering. Radio-Meteorology. Lower Atmosphere Physics.

Radio Standards. High Frequency Electrical Standards. Radio Broadcast Service. High Frequency Impedance Standards. Electronic Calibration Center. Microwave Physics. Microwave Circuit Standards.

Radio Communication and Systems. Low Frequency and Very Low Frequency Research. High Frequency and Very High Frequency Research. Ultra High Frequency and Super High Frequency Research. Modulation Research. Antenna Research. Navigation Systems. Systems Analysis. Field Operations.

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